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Agriculture 4.0 – an opportunity or threat to Polish agriculture

Agricoltura 4.0: un'opportunità o una minaccia per l'agricoltura polacca

The purpose of the article is to assess the state of Polish agricultural law in the implementation of legal and financial mechanisms of Agriculture 4.0. Agriculture 4.0 is a modern concept assuming an approach to agriculture expected to increase efficiency and to balance agricultural production through the use of technology. The technologies currently in use monitor and manage the cultivation processes primarily with the help of remote control of the machinery, using GPS, or robots. As most analyses show, Agriculture 4.0 has become a challenge for new legal solutions and their clear formulation directed at the provision of maximum assistance to farmers. At the same time, there are also risks that without public aid, farmers might be unable to acquire expensive solutions for running their businesses. The adopted research hypotheses also assume an assessment of the state of Polish and European agricultural law in the perspective of technical progress in agriculture in countries outside the EU. The article also emphasises the lack of uniformity of legal instruments designed to assist farmers wishing to take advantage of aid mechanisms available under Agriculture 4.0.

Keywords: agriculture, Common Agricultural Policy, National Strategic Plan, agricultural law, European agricultural law, Agriculture 4.0

L'articolo si propone di valutare lo stato di diritto agrario polacco nell'attuazione dei meccanismi giuridici e finanziari di Agricoltura 4.0. Questa moderna concezione presuppone un approccio all'agricoltura che, attraverso la tecnologia, mira ad aumentare l'efficienza e la sostenibilità della produzione agricola. Queste tecnologie monitorano e gestiscono i processi di coltivazione principalmente attraverso l'uso del controllo remoto di macchine, GPS o robot. Nella maggior parte delle analisi effettuate, l'Agricoltura 4.0 diventa una sfida per nuove soluzioni giuridiche, compresa la loro formulazione, nell'ottimizzare l'assistenza agli agricoltori. Allo stesso tempo, vi sono anche minacce che potrebbero portare a una situazione in cui gli agricoltori, senza aiuti pubblici, non saranno in grado di acquisire soluzioni costose per portare avanti l'attività. Le ipotesi di ricerca adottate presuppongono anche di

valutare lo stato del diritto agrario polacco ed europeo nella prospettiva del progresso tecnico in agricoltura nei Paesi al di fuori dell'UE. Nell'articolo è stato anche messo in evidenza che manca l'uniformità degli strumenti giuridici destinati ad aiutare gli agricoltori interessati a usufruire dei meccanismi di sostegno nell'ambito dell'Agricoltura 4.0.

Parole chiave: agricoltura, politica agricola comune, piano strategico nazionale, diritto agrario, diritto agrario europeo, Agricoltura 4.0

Introduction

Modern agriculture requires legal changes and adaptation to the changing world, particularly in terms of introducing solutions that increase the technicization of agriculture. The adopted principles of the Common Agricultural Policy in the context of the European Union's climate policy intensify the need to look no longer only for smart solutions[1] (such as Smart Village[2]), or innovative solutions, but those that use satellite tools or artificial intelligence to work. Such changes require not only quite considerable financial outlays, but, above all, the creation of a legal framework that would take into account the new requirements of agriculture.

One such approach, along with precision agriculture,[3] zero-carbon, or carbon agriculture,[4] is the concept of Agriculture 4.0. This is a modern approach to agriculture that through technology is expected to increase efficiency and balance agricultural production.[5] These technologies monitor and manage farming processes primarily through the use of remote control of the machinery, GPS, or robots. The idea is that this should lead to better use of resources, reduced costs, and an improved environment.

[1] B. Jeżyńska, *Zrównoważone rolnictwo w rezerwatach biosfery*, "Studia Iuridica" 2020, vol. 94, pp. 143–160.

[2] D.C. Rose, J. Chilvers, *Agriculture 4.0: Broadening responsible innovation in an era of smart farming*, "Front Sustainable Food Systems" 2018, vol. 2.

[3] A. McBratney, B. Whelan, T. Ancev, *Future Directions of Precision Agriculture*, "Precision Agriculture" 2005, vol. 6, p. 7; R. Różycki, K. Żmich, *Wykorzystanie nowoczesnych technologii w rolnictwie precyzyjnym*, in: U. Motowidlak, D. Wronkowski, A. Reńda (eds.), *Różne oblicza logistyki*, Łódź 2018, pp. 97–111.

[4] A. Piwowar, *Low-Carbon Agriculture in Poland: Theoretical and Practical Challenges*, "Polish Journal of Environmental Studies" 2019, vol. 28, no. 4, pp. 2785–2792.

[5] M. de Clercq, A. Vats, A. Biel, *Agriculture 4.0: The Future of Farming Technology*, World Government Summit, 2018, p. 11.

The purpose of the considerations carried out in the article is to present the state of Polish agricultural law against the background of the agricultural legislation of the European Union in the implementation of the solutions of Agriculture 4.0. The challenges facing Polish agriculture will be identified, as well as the risks associated with the use of modern technologies in agriculture, including remote management of agrotechnical processes. These analyses will be made from the perspective of recent years, when the concept of introducing innovations in agriculture has become increasingly prominent in European as well as national regulations. The conducted and ongoing calls for applications for financial assistance within the framework of Agriculture 4.0 will also be evaluated. The law in this area faces the challenge of how to solve the introduction of modern technologies into agriculture, so that they become as effective as possible.

The following research hypotheses will be emphasized in the paper. The first one concerns the assessment of the state of Polish agricultural legislation which requires changes and adaptation to the implementation of the solutions of Agriculture 4.0. Despite the passage of time, Polish agricultural law has not kept up with European changes which, too, as a matter of fact are being introduced with quite a delay. European and Polish regulations focus more on the conditions for granting financial assistance, rather than, for example, on the rights of emerging technological solutions and their effective patenting.[6] There is no developed unified strategy for the development of the Polish model of Agriculture 4.0 either. Another problem is the processing of data, including personal data, obtained in the course of using Agriculture 4.0, for example, the GPS system or drones.[7] The lack of adequate regulations in this area may prove costly in the long run not only due to possible claims,[8] but it may also affect the sphere of criminal law.

The second hypothesis concerns the evaluation of the state of Polish and European agricultural law in the perspective of technical progress in agriculture[9] observed in countries outside the EU. Progressive globalization

[6] R. Abbasi, P. Martinez, R. Ahmad, *The digitization of agricultural industry – a systematic literature review on agriculture 4.0*, "Smart Agricultural Technology" 2022, vol. 2.

[7] M.E. Sykuta, *Big Data in Agriculture: Property Rights, Privacy and Competition in Ag Data Services*, "International Food and Agribusiness Management Review" 2016, no. 19, p. 58.

[8] T. Pawlowski, *Przepisy i regulacje obowiązujące autonomiczne pojazdy rolnicze poruszające się po polu*, "Technika Rolnicza Ogrodnicza Leśna" 2021, no. 1.

[9] A. Schaffner, *Digitization: top value for farmers*, "Agrifuture" 2017, vol. 4, pp. 24–25.

and the race of modern solutions in robotics or artificial intelligence enforce looking at Polish agriculture and its competitiveness also through the prism of agriculture of highly developed countries. The need to adapt to these new requirements is a challenge for Polish agriculture, not only financial, but above all legal, if only in the area of industrial property protection, or new safety rules for work in an environment where the activity of remotely controlled machines and equipment will prevail.[10] An important question also arises as to whether the proposed solutions are indeed meant for family farms,[11] or whether they are dedicated only to farms which through their structure approach enterprises? Regulations in this area should also ensure the development of small farms which will be able to benefit from agriculture 4.0 on a scale that suits their needs.

Another hypothesis concerns the lack of uniformity of legal instruments designed to assist farmers who wish to take advantage of aid mechanisms under Agriculture 4.0. The constant changes and new requirements being introduced are not conducive to the long-term development of agricultural activity. Agriculture needs modern legal solutions, but those must constitute a stable mechanism that will ensure evolution rather than revolution in the system of assistance to farmers and related requirements. In this context, Agriculture 4.0 becomes a challenge for lawyers, but a threat to farmers. Unrefined legal solutions, including in terms of financial assistance, will not serve to encourage farmers to invest in modern solutions. At the same time, without public assistance, most farmers will not be able to economically afford to acquire these solutions for their farms.

1. European regulations – Agriculture 4.0

Issues related to the introduction of Agriculture 4.0 are normalized primarily under the investment milestone knows as A1.4.1 Investments to diversify and shorten the agricultural and food supply chain and to build the resilience of actors in the chain under the National Plan for Rebuilding and Increasing

[10] D.C. Rose, R. Wheeler, M. Winter, M. Lobley, C.A. Chivers, *Agriculture 4.0: Making it work for people, production, and the planet*, "Land Use Policy" 2021, vol. 100.

[11] A. Lichorowicz, *Podstawowe rozwiązania regulujące status prawny gospodarstw rodzinnych w krajach Europy Zachodniej*, in: P. Litwiniuk (ed.), *Prawne mechanizmy wspierania i ochrony rolnictwa rodzinnego w Polsce i innych krajach Unii Europejskiej*, Warsaw 2015, p. 267; idem, *Status prawny gospodarstw rodzinnych w ustawodawstwie krajów Europy Zachodniej*, Białystok 2000.

Resilience.[12] This already exemplifies that Agriculture 4.0 goes far beyond the impact on agriculture itself and includes the entire food supply chain. The task is to shorten this chain in the first place.

These investments are to include, according to the National Plan for Rebuilding and Increasing Resilience adopted by the Council of Ministers in 2021, the diversification of distribution channels through the creation of storage and distribution centers, including the expansion and modernization of logistical and technological infrastructure for the buying, preparation for sale and marketing of agricultural products, with an accompanying digital application system. In addition, investments are envisaged in regional agri-food wholesale markets for storage and marketing infrastructure for agricultural and food products and the creation direct sales sites for local food products.

European regulations leave quite a lot of freedom in the selection of aid instruments for the development of Agriculture 4.0. On the one hand, this is an opportunity for Polish agriculture, because the regional, national selection of mechanisms should most fully respond to the needs of local farmers. On the other hand, it is a threat, because in wealthier countries, with a higher level of agricultural technization, it will be possible to select more advanced solutions that will significantly distort the level of normal competition rules in agriculture.

2. The state of Polish agricultural law and prospects for development

The Decree of the Minister of Agriculture and Rural Development dated July 17, 2023 adopted under the National Plan for Reconstruction and

[12] Other European regulations in this regard are: Commission Regulation (EU) 2022/2472 of December 14, 2022 declaring certain categories of aid in the agricultural and forestry sectors and in rural areas compatible with the internal market in application of Articles 107 and 108 of the Treaty on the Functioning of the European Union, OJ EU L 327 of 21.12.2022, p. 1; Regulation (EU) 2016/679 of the European Parliament and of the Council of April 27, 2016 on the protection of individuals with regard to the processing of personal data and on the free movement of such data and repealing Directive 95/46/EC (General Data Protection Regulation), OJ EU L 119 of 4.05.2016, p. 1, as amended; Regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021 establishing an Instrument for Reconstruction and Increasing Resilience, OJ EU L 57 of 18.02.2021, p. 17, as amended; Commission Delegated Regulation (EU) 2021/2106 of 28 September 2021 on supplementing Regulation (EU) 2021/241 of the European Parliament and of the Council establishing an Instrument for Reconstruction and Increasing Resilience by defining common indicators and detailed elements of the Reconstruction and Increasing Resilience Scoreboard, OJ EU L 429, 1.12.2021, p. 83, as amended.

Increasing Resilience[13] specifies the detailed earmarking, conditions and modalities of support for the implementation by agricultural producers of projects to implement solutions for Agriculture 4.0, consisting of the implementation of ICT systems and digital solutions for handling the processes of production and marketing of agri-food products within the framework of investment A1.4.1 "Investments to diversify and shorten the supply chain of agricultural and food products and build the resilience of entities participating in the chain" covered by the National Plan for Reconstruction and Increasing Resilience, as well as the entity providing support.

It is the basis for providing assistance under the activities and investments included in the NIP. It should be noted that it was issued on the basis of Article 14lc(4) of the Act of 6 December 2006 on the principles of development policy.[14] With its scope of regulation, the Act applies to the entire sphere of the economy, with the exclusion of activities specified in the Rural Areas Development Programme. Therefore, Agriculture 4.0 is part of a broader catalogue of opportunities to obtain assistance from European funds and develop activities not only in the sphere of agriculture.

Assistance can be given meteorological sensors and sensors[15] soil moisture,[16] locating sensors,[17] biosensors,[18] or optical sensors.[19] They make it possible, through the use of state-of-the-art techniques, to carry out farming

[13] Decree of the Minister of Agriculture and Rural Development of July 17, 2023 adopted under the National Plan for Reconstruction and Increasing Resilience, Journal of Laws item 1389.

[14] Act of 6 December 2006 on the principles of development policy, Journal of Laws of 2023, item 1259 and 1273.

[15] Examples include: automatic weather stations with GPRS, LoRaWAN or other transmission, remote humidity and air temperature sensors with short-range radio transmission (e.g., WSNs built on the ZigBee protocol), long-range LoRaWAN or to GSM networks via GPRS.

[16] Soil moisture, among others: capacitive FDR or TDR with radio communication as above; Digital tensiometers with radio communication as above; Resistivity sensors are cheap, but their accuracy depends on pH. They are not recommended for use in precision irrigation.

[17] GPS or GPS-based sensors with RTK/RTN support to enable supervised travel along paths (assisting the tractor operator); Systems for autonomous vehicle control along preset paths n based on GPS/RTK.

[18] Sensors detecting antigens of selected pathogens in aquaculture farms; sensors detecting pathogen antigens in intensive animal husbandry; sensors detecting spores of crop pathogens and pest pheromones

[19] NDVI aboveground sensors connected to a WSN (wireless sensor network); Thermal sensors to detect animals with fever in confined kennels; Sensors to identify and detect diseases and pests; Multispectral cameras for reconnaissance drones to enable field condition monitoring.

activities in a way that is not only safer, but changes the form of agricultural work to one that requires more and more expertise. Agriculture 4.0, in this regard, also needs provisions related to worker protection, including the possibility of upgrading worker skills. In addition, the transfer of tasks previously performed in agriculture by people to machines will force some people employed in agriculture to seek new forms of work. Hence it is necessary to provide for opportunities to help people who will leave agriculture for other occupations.[20]

Paragraph 3(1) of the Ordinance defines the eligible entities for support. It was indicated that support may be granted to an individual who: is subject to full social insurance of farmers under the Act of 20 December 1990 on social insurance of farmers[21] as a farmer, or who has been granted direct payments within the meaning of the provisions of the Act of 5 February 2015 on payments under direct support systems[22] or referred to in the provisions of the Act of 8 February 2023 on the Strategic Plan for the Common Agricultural Policy for 2023–2027[23] at least in the year in which the application for support was submitted, and if these payments have not yet been granted in a given year – at least in the year preceding the year of submission of the application for support, or is an agricultural producer within the meaning of Article 3 point 3 of the Act of 18 December 2003 on the national system of producer records, farm records and records of applications for payment[24] being a holder within the meaning of Article 2 point 16 of the Act of 4 November 2022 on the system of identification and registration of

[20] The use of robots, as indicated on the pages of the Ministry of Agriculture and Rural Development, will consist in using a device controlled remotely or fully autonomous, that will performi tasks after being programmed by the user or an appropriately configured DSS or FMS system. In the world, the most common robots are machines for autonomous cultivation (tractors with cultivation sets controlled by GPS and wireless communication with the control system/programmer), seeding and spraying (self-propelled sets with or without a tractor), robots for plant protection – automatic detection of weeds or pests and mechanical (cutting or burning) their elimination or removal of infested plants. Another branch of agricultural robotics is robotic fruit-harvesting machines, autonomously recognizing the stage of maturity of fruit on the plant and selectively harvesting only those with the right maturity.

[21] Act of 20 December 1990 on social insurance of farmers, consolidation text Journal of Laws of 2023, item 208, 337 and 641.

[22] Act of 5 February 2015 on payments under direct support systems, consolidation text Journal of Laws of 2022, item 1775 and 2727.

[23] Strategic Plan for the Common Agricultural Policy for 2023–2027, Journal of Laws, item 412.

[24] Act of 18 December 2003 on the national system of producer records, farm records and records of applications for payment, consolidation text Journal of Laws of 2023, item 885.

animals.[25] In addition, the eligible person must have been assigned an identification number in accordance with the provisions of the Act of 18 December 2003 on the national system of producer records, farm records and records of applications for payment, and be of age.

Linking the support granted to direct payments means that the beneficiary of this aid can be primarily an active farmer.[26] On the one hand, this is an opportunity for the aid to go into qualified hands, but on the other hand, it results in limiting the circle of beneficiaries only to those who already benefit from the support defined by the provisions of European law in terms of the aid provided for in the National Strategic Plan for the Common Agricultural Policy for 2023–2027.

As indicated in para. 4 (1) of the Regulation, support is granted to projects whose implementation lasts no longer than 12 months from the date of conclusion of the agreement to cover the project with support and no longer than until 30 September 2025. This means that the implementation of the purchase assumed in the application should take place rather quickly. The danger of such a solution may, of course, be problems with the logistical delivery of appropriate solutions and equipment in a fairly short period of time, especially if the mechanisms are quite complex.

A farmer can apply under the regulation for eligible costs from 65% to 80% of their amount.[27] Eligible costs cover the implementation of Agriculture 4.0 solutions, including the purchase of machinery, equipment or software and their assembly and installation, in particular sensors, IT equipment and applications[28] and the purchase of patents and licenses; as

[25] Act of 4 November 2022 on the system of identification and registration of animals, Journal of Laws, item 2727 and of 2023, item 412.

[26] P. Iwaszkiewicz, P. Litwiniuk, *O znaczeniu koncepcji gospodarstwa rodzinnego, rolnika aktywnego zawodowo i rolnika indywidualnego w systemie planowania strategicznego WPR*, "Studia Iuridica" 2021, vol. 87, pp. 137–152; P. Litwiniuk, *Aktywny rolnik – nowy beneficjent wsparcia bezpośredniego w ramach WPR*, "Przegląd Prawa Rolnego" 2015, no. 1, pp. 211–228.

[27] 1) up to 80% of these costs – in the case of: a) applicants engaged in organic production within the meaning of Article 2(1)(10) of the Act of June 23, 2022 on organic farming and production (Journal of Laws of 2023, item 1235), b) applicants born after December 31, 1982 – for applications submitted in 2023, c) applicants born after December 31, 1983 – for applications submitted in 2024; 2) up to 65% of these costs – for other applicants. Support is granted up to the limit, which is PLN 200,000 per project of the final recipient of support. Support is granted for an undertaking if the amount of support requested for this undertaking is not less than PLN 15,000.

[28] Costs for the purchase and installation of new process lines and Agriculture 4.0 machinery and equipment for the production of primary agricultural products (such as sensors,

well as general, directly related to the preparation and implementation of the project. The assistance is provided through reimbursement, which in itself is quite a sensible solution, as it safeguards against the purchase of equipment dedicated to Agriculture 4.0 by entities that will have no idea how to use it. On the other hand, it significantly limits the circle of eligible entities who will be able to afford to purchase such solutions in order to later apply for reimbursement. The investment risk incurred may prove too great for some farmers to take advantage of these aids.[29]

A certain solution in this regard is provided for in para. 9 of the Ordinance, where it is stipulated that an advance of 50% of the value of the support may be granted and paid for the implementation of a project, if the applicant has applied for this advance and its payment in the application for support, and the project has not been started before the date of submission of the application for support. The condition for applying for payment of the advance is that the applicant has a separate bank account or an account with a cooperative savings and credit union, to which the advance will be transferred. Such

sensors, drones, monitoring, control and production management systems tensiometers, probes, pedometers, accelerometers, data transmission base stations, weather stations) or for the digital marketing of agricultural products, including the purchase and installation on the farm of new Agriculture 4.0 that can be mounted on existing agricultural machinery or process lines, buildings and structures on the farm (these costs do not include the purchase of tractors, harvesting machines, fertilizer spreaders, sprayers that do not work with the digital infrastructure of the farm) – in accordance with the Regulations on the selection of projects for support from the NOP under the investment part A 1.4.1. support for Agriculture 4.0.

[29] An example of digitization of a farm according to Annex 1 to the Regulations for the selection of projects to be supported by the NIP under investment part A 1.4.1 support for Agriculture 4.0. "From the cloud to the field: A farmer with grain crops buys a farm management system with a subscription to map his field, carry out inventory management and machinery management, and generate automatic reports for reports, including the food passport. Field mapping was done by the company based on satellite images and soil quality measurements. Thanks to the mapping, the farmer has clearly demarcated zones for the use of precision agriculture: irrigation, fertilization as well as the selection of the right crop rotation and seeding standards. Zoning will also enable the selection of optimal tillage operations to improve the quality of soils, especially light soils. The farmer, already in possession of soil richness zone maps, will buy a VRA (Variable Rate Application) fertilizer spreader to more precisely match the fertilizer application rate to the richness of the soils and their buffering capacity and pH. This allowed the farmer to save up to 30% of fertilizer. The farmer bought a network of soil moisture sensors with a controller to control the level of the levee in the drainage ditch, as well as the DSS decision support module of the farm management system to control the levee based on soil moisture. This slowed down runoff and made the drought less severe. The next modules to be purchased in this scheme are: DSS for precision crop protection, pathway cultivation or autonomous equipment," p. 5.

a solution only half solves the problem outlined, but provides some support for the purchase of equipment and technological solutions.

Conclusions

The analysis presented in the paper clearly indicates that Polish agricultural law is rather inadequately prepared for the implementation of legal solutions of Agriculture 4.0. There is a need for comprehensive, long-term solutions not only related to financial assistance, but also to the legal consequences of using modern solutions in agriculture. One example, of course, is the simplified way of using patent law for the implementation of know-how in agriculture. Another problem is the regulation of the consequences of the use of GPS in the conduct of agricultural activities and the possibility of inspecting every activity carried out by devices that have GPS installed. The legal processing of personal data obtained, for example, by drones within the framework of Agriculture 4.0[30] is also a problem.

The challenge will undoubtedly be to meet the competition of agriculture of countries outside the EU, such as the USA or China, where technological progress and the transfer of modern solutions to the economy is significantly accelerating. This is also facilitated by the development of artificial intelligence which is also being implemented in agriculture. European farmers without financial assistance will not be able to compete with farmers from third countries. The huge interest in Agriculture 4.0 assessed through the prism of submitted applications shows that farmers see this as the future and an increase in the profitability of their farms. At the same time, the rather significant increase in the levels of public spending on these activities, such as in Poland, also points to a danger, which shows that without (significant) public aid farmers in Europe will not be able to implement Agriculture 4.0 solutions themselves on their farms. Therefore, it is necessary to postulate that public aid should be maintained in this regard, and also increased, taking into account other types of assistance.

It would also be appropriate to consider normalizing the circle of beneficiaries and possibly broadening the scope of access to the aid received. This should increase the possibility of implementing modern solutions in agriculture. To this end, an *ex ante* evaluation of the ongoing distribution of funds should be carried out. Quite a lot of interest among farmers, which resulted

[30] C. Zapala, *Processing of information and personal data in agriculture under Big Data*, "Studia Iuridica" 2018, vol. 78, pp. 517–533.

in the current aid budget of PLN 1,134,66 million, shows that farmers not only need support in this regard, but, above all, are willing to modernize their farms towards the use of modern technologies, not only precision agriculture, but also Agriculture 4.0, such as the use of drones.[31]

Agriculture 4.0 is the future for agriculture in Europe. Only fairly rapid technicization using robots, GPS systems, or other modern solutions related, for example, to artificial intelligence will determine the competitiveness of this agriculture in the future. The law faces the challenge of regulating the use of these devices both in terms of administrative and civil law regulation. This opportunity should not be wasted.

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[31] S. Ahirwar, R. Swarnkar, S. Bhukya, G. Namwade, *Application of Drone in Agriculture*, "International Journal of Current Microbiology and Applied Sciences" 2019, no. 8(1), pp. 2500–2505; A. Kuliczkowska, *Problems of regulating the legal status of autonomous vehicles*, "Market – Society – Culture" 2017, no. 26, pp. 180–185. For example, one can only point to executive drones, i.e. drones that carry out the application of active agents or fertilizers according to the principles of precision agriculture, i.e. only where needed and only as much as necessary. Drones can operate autonomously on the basis of maps opened by observation drones, for example, or directly on the basis of self-observation. There are also reconnaissance drones equipped with specialized cameras, used for: mapping plant vigor, which gives information about the state of the canopy/plantation and locating where there are water or ingredient deficiencies; detecting disease outbreaks or pest expansion, or hunting damage.

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